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The Psychological Impact of the COVID-19 Pandemic on Healthcare Workers at Acute Hospital Settings in the South-East of Ireland – An Observational Cohort Multi-Centre Study

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TITLE

The Psychological Impact of the COVID-19 Pandemic on Healthcare Workers at Acute Hospital Settings in the South-East of Ireland – An Observational Cohort Multi-Centre Study

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ABSTRACT

Objective

Our study aims to understand the psychological impact of the COVID-19 pandemic among healthcare workers (HCWs) at acute hospital settings in the South-East of Ireland, as a crucial step in guiding policies and interventions to maintain their psychological well-being.

Design

Observational Cohort Study

Participants and Setting

472 HCWs participated from two distinct acute hospital settings, A and B, in the South-East of Ireland.

Primary and Secondary Outcome Measures

Measures of psychological distress - depression, anxiety, acute and post-traumatic stress (PTSD) - as dictated by the Depression, Anxiety and Stress Scale (DASS-21) and Impact of Event Scale – Revised (IES-R). An independent sample t-test and a Mann Whitney U test was used to determine significance of difference in continuous variables between groups. Categorical variables were assessed for significance with a chi-squared test for independence.

Results

The DASS-21 provided independent measures of depression (mean 4.57, IQR 2 to 7), anxiety (mean 3.87, IQR 1 to 6) and stress (mean 7.41, IQR 4 to 10). Positive scores were reflected in 201 workers (42.6%) for depression and 213 (45.1%) for both anxiety and stress. The IES-R measured subjective distress on three subscales: intrusion (mean 1.085, IQR 0.375 to 1.72), avoidance (mean 1.008, IQR 0.375 to 1.5) and hyperarousal (mean 1.084, IQR 0.5 to 1.667). Overall, 195 cases (41.3%) were concerning for PTSD. Site B scored significantly higher across all parameters of depression (5.24 vs 4.08, $p<0.01$), anxiety (4.66 vs 3.3, $p<0.01$), stress (8.91 vs 6.33, $P<0.01$) and PTSD (0.058 vs 0.043, $P<0.01$). Worse outcomes were also noted in HCWs with underlying medical ailments.

Conclusion

To date there is a paucity of research addressing significant mental health hazards during the COVID-19 pandemic. It is important to note such issues can be both immediate and remote; therefore, it will be important to examine the long-term sequelae.

ARTICLE SUMMARY**Strengths and Limitations of this Study**

- The study assessed the psychological impact of the pandemic on healthcare workers through validated questionnaires; one of few studies to address this topic to date for Irish hospital settings.
- Access to data covering different worker cohorts and acute hospital settings enabled the use of comparative groups, strengthening statistical analyses.
- Findings relied on a self-reported survey which may question the authenticity of responses.
- Socioeconomic status was not recorded, which may be important in evaluating associations of outcomes and tailoring specific interventions.
- The study was conducted towards the end of the initial outbreak and at settings only in the south-east which impairs the generalizability of the findings.

For peer review only

INTRODUCTION:

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3 In December 2019, Wuhan, China became the centre of an outbreak of pneumonia of unknown cause,
4 later identified as SARS-CoV-2, and designated the 2019 novel coronavirus (COVID-19) by the World Health
5 Organisation (WHO). This particular strain showed marked virulence and mortality; being declared a global
6 pandemic on March 11th 2020.[1,2]
7

8
9 The Republic of Ireland (ROI) saw its first SARS-CoV-2 case on 29th February 2020, with its first attributed
10 death on 11th March 2020. Initial projections predicted up to 1.9 million infected individuals unless drastic
11 action from government officials and the public was taken.[3]
12

13
14 Hospitals experienced an extreme restructuring, with a swift change in team allocations and dynamics and
15 ensuing bombardment with protocols and information. These were untested waters, and healthcare
16 workers (HCWs) were thrown into this new, frightening environment. They were facing a new viral strain
17 with no recognised evidence-based antiviral therapy and finite resources.
18

19
20 With Public Health interventions, as of 1st July 2020, the total number of confirmed cases in the ROI was 25
21 471, with a plateauing of the cumulative epidemiological curve. Of those cases, 1 4 77 represented
22 fatalities, 7 of which were HCWs, with 2 employed in an acute hospital in the South-East. Altogether, 8 215
23 cases were amongst HCWs, with worrying rates of HCW transmission noted in one of the 2 institutions
24 studied.[4]
25

26
27 Self-care is a familiar concept but HCWs have an intrinsic sense of duty of care toward their patients. They
28 dedicate their time and energy, and on many occasions put the wellbeing of patients above their own.
29 They may not feel empowered to exercise their right to self-care when facing a health crisis affecting those
30 they are called to aid.
31

32
33 Undoubtedly, working in such unprecedented times would affect one's mental well-being. A study
34 undertaken in Singapore found HCWs suffered from a high level of psychological distress and represent a
35 vulnerable group where psychological intervention may be beneficial.[5]
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38 With this in mind, our study aims to understand the psychological impact of the COVID-19 pandemic
39 among HCWs at acute hospital settings in the South-East of Ireland, as a crucial step in guiding policies and
40 interventions to maintain their psychological well-being.
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METHODOLOGY:

Design and Setting

This is an observational cohort multi-centre study of HCWs at acute hospital settings in the South-East of Ireland, and has been approved by the Research Ethics Committee, Health Service Executive (HSE), South-East.

Data Collection

From 8th June 2020 to 22nd June 2020, HCWs from the aforesaid region, were invited to participate with a self-administered electronic survey. The survey was created via Smart Survey and distributed via the HSE Secure Web Mail service; permission was secured from all relevant stakeholders. In addition to demographic characteristics, including age, gender, relationship status, occupation, medical history and direct involvement with COVID-19 patients, the questionnaire included the validated Depression, Anxiety, and Stress Scale (DASS-21) and the Impact of Events Scale–Revised (IES-R) instrument.[6, 7] Participants were also asked to offer suggestions on how working through the COVID-19 pandemic could have been improved in terms of support of HCWs. Only one response per person to the survey was permitted with quality control performed daily through Smart Surveys inherent coding. Information on available support services were also provided to participants.

Validated Rating Scales

The depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, anhedonia and inertia. The anxiety scale assesses autonomic arousal, situational anxiety and subjective experience of anxious affect. The stress scale is sensitive to levels of chronic non-specific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset or agitated. The DASS-21 is based on a *dimensional* rather than a *categorical* conception of psychological disorder, that is, it assumes that differences between depression, anxiety and stress experienced by normal subjects and clinical populations are differences of degree. The DASS-21 therefore has no direct implications for the allocation of patients to discrete diagnostic categories postulated in classificatory systems such as the International Classification of Diseases (ICD) and Diagnostic and Statistical Manual of Mental Disorders (DSM).[6]

The IES-R is a self-report measure that assesses subjective distress caused by traumatic events and represents a measure of PTSD symptoms. There are three subscales: intrusion (intrusive thoughts, feelings and imagery, nightmares, dissociative-like re-experiencing), avoidance (numbing of responsiveness, avoidance of feelings, situations, and ideas), and hyperarousal (anger, irritability, hypervigilance, difficulty concentrating, heightened startle), as well as a total subjective stress IES-R score.[7]

Study Outcomes

The primary outcome was the prevalence of depression, anxiety, stress and post-traumatic stress disorder (PTSD) among all HCWs.

Statistical Analyses

Data analysis was performed using IBM SPSS version 26. Continuous variables were summarized as means within each group; categorical variables were described as percentages with frequency counts. An independent sample t-test and a Mann Whitney U test was used to determine significance of difference in continuous variables between groups. For categorical variables, a chi-squared test for independence was used to test for statistical significance. A p value of <0.05 was deemed significant.

Patient and Public Involvement

There was no patient or public involvement in the production of this study.

RESULTS:

In total, 472 HCWs participated in the study from two distinct hospital settings – 58.3% (275) HCWs at Site A and 41.7% (197) HCWs at Site B, representing a response rate of 24.5% and 19.9% respectively. Overall, 69.1% of respondents were female, with an average age of 40.7 years. There was a relatively even distribution between medical and non-medical staff, 47.9% versus 52.1%, with 57.6% HCWs reporting direct interaction with COVID-19 patients. 36.2% of participants had underlying health conditions (Table 1).

The DASS-21 provided independent measures of depression (mean 4.57, IQR 2 to 7), anxiety (mean 3.87, IQR 1 to 6) and stress (mean 7.41, IQR 4 to 10) with scores greater than 4, 3 and 7 indicating positive screens respectively.[6] This was detected in 42.6% workers for depression and 45.1% for both anxiety and stress (Table 2).

The IES-R measured subjective distress on 3 subscales: intrusion (mean 1.085, IQR 0.375 - 1.72), avoidance (mean 1.008, IQR 0.375 - 1.5) and hyperarousal (mean 1.084, IQR 0.5 - 1.667). These subscales are closely associated with PTSD. A gross total IES-R score greater than 24 or an overall mean of 1.09 is clinically concerning for PTSD[7] which was present in 41.3% of participants in this study (Table 2).

Abovementioned scoring tools were also compared between defined groups – genders, occupations, hospital sites, COVID-19 interactions, relationships and morbidity (Table 3). Significant differences were noted between hospital sites, with Site B reporting worse mean scores in depression (5.24 vs 4.08, $p < 0.01$), anxiety (4.66 vs 3.3, $p < 0.01$), stress (8.91 vs 6.33, $P < 0.01$) and PTSD (0.058 vs 0.043, $P < 0.01$) as compared to Hospital Site A. Similarly, HCWs with underlying medical ailments scored significantly higher across the DASS-21 and IES-R (Table 3).

63.8% participants offered suggestions on how working through the pandemic could have been improved, in terms of support of HCWs. Common responses included, but were not limited to, inclusiveness and involvement in decision making (86%), succinct and timely communication (83%), facilitating rest areas and staggered rosters (78%), improvement of staffing levels to facilitate effective patient care yet allow leave entitlements and social distancing (69%), on site mental health supports with a degree of personal interaction (66%), increased frequency of multidisciplinary educational and training sessions (66%) and development of childcare facilities (51%).

Table 1: Participant Characteristics at Baseline

Average Age (IQR), years	40.7 (32 - 48)
Gender, % (n)	
Male	30.93 (146)
Female	69.07 (326)
*Relationship Status, % (n)	
Married	55.08 (260)
In A Committed Relationship	19.92 (94)
Single	18.22 (86)
Divorced / Separated	6.14 (29)
Widowed	0.64 (3)
Place of Employment, % (n)	
Hospital Site A	58.26 (275)
Hospital Site B	41.74 (197)
**Occupation, % (n)	
Doctor	19.28 (91)
Nurse	29.03 (137)
Clerical or Administrative Staff	13.77 (65)
Catering	1.48 (7)
Pharmacy	2.54 (12)
Security	4.87 (23)
Portering	1.27 (6)
Domestic	2.54 (12)
Laboratory	4.45 (21)
Maintenance	2.12 (10)
Healthcare Assistant	4.66 (22)
Allied Health Care	10.38 (49)
Management	0.64 (3)
Audiologist	0.42 (2)
Radiographer	2.54 (12)
Interaction with COVID-19 Patients, % (n)	
Yes	57.63 (272)
No	42.37 (200)
Underlying Medical Conditions, % (n)	
None	63.77 (301)
Hypertension	13.13 (62)
Dyslipidaemia	5.30 (25)
Elevated Body-Mass-Index	4.87 (23)
Diabetes	1.91 (9)
Obstructive Airway Disease	7.63 (36)
Heart Disease	0.63 (3)
Smoking	10.81 (51)
Other	4.45 (21)

Table 2: Prevalence of Depression, Anxiety, Stress and PTSD and Mean Scores of the DASS-21 and IES-R

Mean Depression, Anxiety and Stress Scale-21 Scores, (IQR)	
DASS Depression	4.57 (2 to 7)
DASS Anxiety	3.87 (1 to 6)
DASS Stress	7.41 (4 to 10)
Depression, Anxiety and Stress Prevalence, n (%)	
Depression	201 (42.58)
Anxiety	213 (45.13)
Stress	213 (45.13)
Mean Impact of Event Scale – Revised Scores, (IQR)	
IES-R Avoidance	1.01 (0.38 to 1.50)
IES-R Intrusion	1.09 (0.38 to 1.72)
IES-R Hyperarousal	1.08 (0.50 to 1.67)
IES-R Total	0.05 (0.02 to 0.08)
PTSD Prevalence, n (%)	195 (41.31)

*For comparative analysis, participants either “Married” or “In A Committed Relationship” was classified as having Relationship Support, whilst “Single”, “Divorced / Separated” and “Widowed” were classified as Without Relationship Support. **Occupations were further grouped into Medical (Doctors and Nurses) and Non-Medical (All Others).

Characteristic	Proportion, %	DASS-21 Depression (Mean)	p-value	DASS-21 Anxiety (Mean)	p-value	DASS-21 Stress (Mean)	p-value	IES-R Avoidance (Mean)	p-value	IES-R Intrusion (Mean)	p-value	IES-R Hyperarousal (Mean)	p-value	IES-R Total (Mean)	p-value
Gender															
Male	30.9	4.34	0.38	3.44	0.07	6.99	0.15	0.91	0.06	0.98	0.08	0.96	0.02	0.043	0.02
Female	69.1	4.67		4.06		7.6		1.05		1.13		1.14		0.051	
Relationship Status															
Relationship Support	75	4.46	0.28	3.89	0.86	7.42	0.9	0.99	0.28	1.07	0.66	1.06	0.39	0.048	0.39
Without Relationship Support	25	4.88		3.82		7.36		1.07		1.11		1.14		0.052	
Place of Employment															
Hospital Site A	58.3	4.08	<0.01	3.3	<0.01	6.33	<0.01	0.89	<0.01	0.93	<0.01	0.95	<0.01	0.043	<0.01
Hospital Site B	41.7	5.24		4.66		8.91		1.17		1.3		1.26		0.058	
Occupation															
Medical	47.9	4.54	0.9	4.11	0.15	7.41	0.99	0.99	0.71	1.06	0.48	1.05	0.34	0.048	0.34
Non-Medical	52.1	4.59		3.65		7.41		1.02		1.11		1.12		0.051	
Direct Interaction with COVID-19 Patients															
Yes	57.6	4.57	0.91	4.13	0.05	7.39	0.96	0.99	0.61	1.07	0.67	1.07	0.73	0.049	0.73
No	42.4	4.53		3.49		7.41		1.03		1.1		1.1		0.05	
Underlying Medical Condition															
Yes	36.2	5.56	<0.01	5.05	<0.01	8.47	<0.01	1.2	<0.01	1.36	<0.01	1.32	<0.01	0.06	<0.01
No	63.8	4		3.2		6.8		0.9		0.93		0.95		0.043	

Table 3: Comparison of DASS-21 and IES-R Scores among Subgroups of Sample Population and Statistical Significance

DISCUSSION:

The ongoing COVID-19 pandemic is a global challenge which has resulted in significant mortality and morbidity worldwide, with more than 10 million cases and 500 000 deaths as of July 2020.[8] As the disease spreads at a rapid pace, most affected countries have had difficulties in meeting the demands for supply of personal protective equipment (PPE) and infrastructure. It has ravaged economies and social integrity, with a rising concern about mental health challenges.[9] With increased demands on an already taut healthcare sector, HCWs are faced with increased workload - with the ever-present risk of infection and the fear of transmission to their loved ones. Often times they require self-quarantine when in contact with COVID-19 confirmed patients; and when coupled with social isolation and discrimination - results in complex emotional reactions.[10] Furthermore, the conflict between professionalism and personal fear for oneself has been linked to burnout with physical and psychological manifestations.

A recent study involving 1563 health professionals reported that 50.7% of participants reported depressive symptoms, 44.7% anxiety and 36.1% sleep disturbance.[11] Similar findings were uncovered in our study; with 42.58% of our populace scoring positive for depression, 45.13% for anxiety and 45.13% for stress, as per the DASS-21.

Table 3 shows a significant difference between the hospital sites, with Site B demonstrating higher scores across all disciplines. It is important to note that Site B experienced significant nosocomial transmission and mortality related to COVID-19 compared to Site A. This demonstrates how experiences truly shape emotions.[12]

Likewise, individuals suffering from medical conditions presented with higher statistically significant scores, likely attributed to the fact that those with comorbidity experienced poorer outcomes if COVID-19 was contracted.[13]

Scores were largely statistically insignificant between other groups, but it is interesting to note that the mean scores were higher overall than scores obtained from Singaporean HCWs, where a comparable study was conducted.[5] This could reflect varied pandemic responses, resource allocation and other environmental circumstances.

A recent systematic review examined 61 viral epidemic outbreak studies and concluded that the prevalence of anxiety, depression, acute and post-traumatic stress disorder, and burnout was high during and after outbreaks; with problems having a long-lasting effect on the mental health of HCWs.[14] The prevalence of distress was higher than those being reported in our study, perhaps due to increased mental preparedness and rigorous infection control principles, as learnt from previous outbreaks.[5] The review also assessed the impact of educational and training initiatives employed to boost resilience and promote pandemic self-efficacy and interpersonal problem solving, of which had low evidentiary certainty.[14] In our study, more than 50% of sampled HCWs suggested the need for more education and training with a multidisciplinary approach, together with involvement in decision making. To boost morale, it has also been suggested to introduce shorter working periods, regular breaks and rotating shifts.

HCWs also recognised the need for psychological supports and we acknowledge the inadequacy of services to provide counselling for HCWs who have been dealing with infected persons; further limited by social distancing.

Our study is a mere snapshot of the present psychological state of our HCWs but we must prepare for future challenges. Many HCWs may develop PTSD, depression, anxiety and burnout *after* the cessation of the pandemic, which becomes an urgent public health concern.[9] This is particularly worrying while facing

1 a likely resurgence of SARS-CoV-2 infection during the winter influenza season, when HCW resilience may
2 be low.[15]
3

4 The liaison mechanism of mental health services needs to be strengthened and improved with a
5 management system which promotes collaboration among organisations. Furthermore, the team of
6 mental health professionals needs to be expanded and strengthened. In an age of technological
7 advancement, online emergency psychological intervention based on artificial intelligence, community
8 based scientific dissemination and social bond enhancement, virtual reality and neuromodulation-based
9 intervention and human resources training for emergency intercession become more relevant, as
10 proposed by Chinese psychologists.[16]
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12

13
14 We recognize limitations in our study. Our findings rely on a self-reported survey which may question the
15 authenticity of response. Socioeconomic status was also not recorded, which may be important in
16 evaluating associations of outcomes and tailoring specific interventions. Lastly, the study was conducted
17 towards the end of the outbreak and at settings only in the south-east which impairs the generalizability of
18 the findings.
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CONCLUSION:

COVID-19 carries significant mental health hazards; to date there is a paucity of research addressing the mental health issues during the pandemic. It is important to note that matters can be both immediate and remote, and it will be important to examine the long-term sequelae of this contagion. There also exists room to explore the feasibility and efficacy of psychotherapeutic interventions, together with provision of support mechanisms for HCWs.

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Author Contributorship:

The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. S.A. is the guarantor and had conceptualised and designed the study with support from M.D. and C.S. Data was collected by S.A. and E.M. with S.M. performing all our data analysis and interpretation. S.A. prepared the drafted article which was critically revised by C.S., S.M. and M.D., with the final approval of the version to be published given by all authors.

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Conflicts of Interest:

No competing interests. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical Approval:

The study has been reviewed and approved by the Research Ethics Committee, Health Service Executive (HSE), South-East, Reference Number 033/2020.

Transparency:

The manuscript's guarantor affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

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Data Sharing:

Data are available upon reasonable request. The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Patient and public involvement:

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research

Patient consent for publication:

Not required.

Provenance and peer review:

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	5
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	6-8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	6-8
Outcome data	15*	Report numbers of outcome events or summary measures over time	6-8

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8
10				
11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	9-10
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9-10
15				
16	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10
17				
18				
19	Generalisability	21	Discuss the generalisability (external validity) of the study results	9-10
20				
21	Other information			
22	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12
23				
24				

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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The Psychological Impact of the COVID-19 Pandemic on Healthcare Workers at Acute Hospital Settings in the South-East of Ireland – An Observational Cohort Multi-Centre Study

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TITLE

The Psychological Impact of the COVID-19 Pandemic on Healthcare Workers at Acute Hospital Settings in the South-East of Ireland – An Observational Cohort Multi-Centre Study

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ABSTRACT

Objective

Our study aims to understand the psychological impact of the COVID-19 pandemic among healthcare workers (HCWs) at acute hospital settings in the South-East of Ireland, as a crucial step in guiding policies and interventions to maintain their psychological well-being.

Design

Observational Cohort Study

Participants and Setting

472 HCWs participated from two distinct acute hospital settings, A and B, in the South-East of Ireland.

Primary and Secondary Outcome Measures

Measures of psychological distress - depression, anxiety, acute and post-traumatic stress (PTSD) - as dictated by the Depression, Anxiety and Stress Scale (DASS-21) and Impact of Event Scale – Revised (IES-R). An independent sample t-test and a Mann Whitney U test was used to determine significance of difference in continuous variables between groups. Categorical variables were assessed for significance with a chi-squared test for independence.

Results

The DASS-21 provided independent measures of depression (mean 4.57, IQR 2 to 7), anxiety (mean 3.87, IQR 1 to 6) and stress (mean 7.41, IQR 4 to 10). Positive scores were reflected in 201 workers (42.6%) for depression and 213 (45.1%) for both anxiety and stress. The IES-R measured subjective distress on three subscales: intrusion (mean 1.085, IQR 0.375 to 1.72), avoidance (mean 1.008, IQR 0.375 to 1.5) and hyperarousal (mean 1.084, IQR 0.5 to 1.667). Overall, 195 cases (41.3%) were concerning for PTSD. Site B scored significantly higher across all parameters of depression (5.24 vs 4.08, $p < 0.01$), anxiety (4.66 vs 3.3, $p < 0.01$), stress (8.91 vs 6.33, $P < 0.01$) and PTSD (0.058 vs 0.043, $P < 0.01$). Worse outcomes were also noted in HCWs with underlying medical ailments.

Conclusion

Psychological distress is prevalent among HCWs during the COVID-19 pandemic; screening for adverse mental and emotional outcomes and developing timely tailored preventative measures with effective feedback are vital to protect their psychological well-being, both in the immediate and long-term.

ARTICLE SUMMARY

Strengths and Limitations of this Study

- The study assessed the psychological impact of the pandemic on healthcare workers through validated questionnaires; one of few studies to address this topic to date for Irish hospital settings; and with access to data covering different worker cohorts and acute hospital settings enabled the use of comparative groups, strengthening statistical analyses.
- Findings relied on a self-reported survey which may question the authenticity of responses and give consideration to recall bias.
- Socioeconomic status was not recorded, which may be important in evaluating associations of outcomes and tailoring specific interventions.
- The study was conducted towards the end of the initial outbreak and at settings only in the south-east which impairs the generalizability of the findings and lends to selection bias.
- There was no pre- and post- COVID-19 pandemic study conducted, therefore it is difficult to ascertain whether it is truly COVID-19 or other intrinsic or extrinsic factors accountable for the psychological impact seen.

INTRODUCTION:

1
2
3 In December 2019, Wuhan, China became the centre of an outbreak of pneumonia of unknown cause,
4 later identified as SARS-CoV-2, and designated the 2019 novel coronavirus (COVID-19) by the World Health
5 Organisation (WHO). This particular strain showed marked virulence and mortality; being declared a global
6 pandemic on March 11th 2020.[1,2]
7

8
9 The Republic of Ireland (ROI) saw its first SARS-CoV-2 case on 29th February 2020, with its first attributed
10 death on 11th March 2020. Initial projections predicted up to 1.9 million infected individuals unless drastic
11 action from government officials and the public was taken.[3]
12

13
14 Hospitals experienced an extreme restructuring, with a swift change in team allocations and dynamics and
15 ensuing bombardment with protocols and information. These were untested waters, and healthcare
16 workers (HCWs) were thrown into this new, frightening environment. They were facing a new viral strain
17 with no recognised evidence-based antiviral therapy and finite resources.
18

19
20 With Public Health interventions, as of 28th October 2020, the total number of confirmed cases in the ROI
21 was 58 047, with a plateauing of the cumulative epidemiological curve. Of those cases, 1 889 represented
22 fatalities, 8 of which were HCWs, with 2 employed in an acute hospital in the South-East. Altogether, 10
23 203 cases were amongst HCWs, with worrying rates of HCW transmission noted in one of the 2 institutions
24 studied.[4]
25

26
27 Self-care is a familiar concept but HCWs have an intrinsic sense of duty of care toward their patients. They
28 dedicate their time and energy, and on many occasions put the wellbeing of patients above their own.
29 They may not feel empowered to exercise their right to self-care when facing a health crisis affecting those
30 they are called to aid.
31

32
33 Undoubtedly, working in such unprecedented times would affect one's mental well-being.[5] A study
34 undertaken in Singapore found HCWs suffered from a high level of psychological distress and represent a
35 vulnerable group where psychological intervention may be beneficial.[6]
36

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38 With this in mind, our study aims to understand the psychological impact of the COVID-19 pandemic
39 among HCWs at acute hospital settings in the South-East of Ireland, as a crucial step in guiding policies and
40 interventions to maintain their psychological well-being.
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METHODOLOGY:

Design and Setting

This is an observational cohort multi-centre study of HCWs at acute hospital settings in the South-East of Ireland, and has been approved by the Research Ethics Committee, Health Service Executive (HSE), South-East.

Data Collection

From 8th June 2020 to 22nd June 2020, HCWs at two acute hospital settings, A and B, from the aforesaid region were invited to participate with a self-administered electronic survey. The survey was created via Smart Survey and distributed via the HSE Secure Web Mail service; permission was secured from all relevant stakeholders. Assuming a 5% statistical significance in a population of 2112 HCWs, a sample size of at least 326 HCWs is sought. In addition to demographic characteristics, including age, gender, relationship status, occupation, medical history and direct involvement with COVID-19 patients, the questionnaire included the validated Depression, Anxiety, and Stress Scale (DASS-21) and the Impact of Events Scale–Revised (IES-R) instrument.[7, 8] Participants were also asked to offer suggestions on how working through the COVID-19 pandemic could have been improved in terms of support of HCWs. Only one response per person to the survey was permitted with quality control performed daily through Smart Surveys inherent coding. Information on available support services were also provided to participants.

Validated Rating Scales

The depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, anhedonia and inertia. The anxiety scale assesses autonomic arousal, situational anxiety and subjective experience of anxious affect. The stress scale is sensitive to levels of chronic non-specific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset or agitated. Scores greater than 4, 3 and 7 are clinically concerning for depression, anxiety and stress respectively. The DASS-21 is based on a *dimensional* rather than a *categorical* conception of psychological disorder, that is, it assumes that differences between depression, anxiety and stress experienced by normal subjects and clinical populations are differences of degree. The DASS-21 therefore has no direct implications for the allocation of patients to discrete diagnostic categories postulated in classificatory systems such as the International Classification of Diseases (ICD) and Diagnostic and Statistical Manual of Mental Disorders (DSM).[7]

The IES-R is a self-report measure that assesses subjective distress caused by traumatic events and represents a measure of PTSD symptoms. There are three subscales: intrusion (intrusive thoughts, feelings and imagery, nightmares, dissociative-like re-experiencing), avoidance (numbing of responsiveness, avoidance of feelings, situations, and ideas), and hyperarousal (anger, irritability, hypervigilance, difficulty concentrating, heightened startle), as well as a total subjective stress IES-R score. A gross total IES-R score greater than 24 or an overall mean of 1.09 is clinically concerning for PTSD.[8]

Both scales demonstrate excellent internal consistency, discriminative and convergent validities with Cronbach's alpha coefficient values of 0.81, 0.89 and 0.78 for the subscales of depression, anxiety and stress respectively and 0.95 for total IES-R scores.[7, 8]

Study Outcomes

The primary outcome was the prevalence of depression, anxiety, stress and post-traumatic stress disorder (PTSD) among all HCWs.

Statistical Analyses

Data analysis was performed using IBM SPSS version 26. Continuous variables were summarized as means within each group; categorical variables were described as percentages with frequency counts. An independent sample t-test and a Mann Whitney U test was used to determine significance of difference in continuous variables between groups. For categorical variables, a chi-squared test for independence was used to test for statistical significance. A p value of <0.05 was deemed significant.

Patient and Public Involvement

There was no patient or public involvement in the production of this study.

For peer review only

RESULTS:

In total, 472 HCWs participated in the study from two distinct hospital settings – 58.3% (275) HCWs at Site A and 41.7% (197) HCWs at Site B, representing a response rate of 24.5% and 19.9% respectively. Overall, 69.1% of respondents were female, with an average age of 40.7 years. There was a relatively even distribution between medical and non-medical staff, 47.9% versus 52.1%, with 57.6% HCWs reporting direct interaction with COVID-19 patients. 36.2% of participants had underlying health conditions (Table 1).

The DASS-21 provided independent measures of depression (mean 4.57, IQR 2 to 7), anxiety (mean 3.87, IQR 1 to 6) and stress (mean 7.41, IQR 4 to 10) with scores greater than 4, 3 and 7 indicating positive screens respectively.[7] This was detected in 42.6% workers for depression and 45.1% for both anxiety and stress (Table 2).

The IES-R measured subjective distress on 3 subscales: intrusion (mean 1.085, IQR 0.375 - 1.72), avoidance (mean 1.008, IQR 0.375 - 1.5) and hyperarousal (mean 1.084, IQR 0.5 - 1.667). These subscales are closely associated with PTSD. A gross total IES-R score greater than 24 or an overall mean of 1.09 is clinically concerning for PTSD[8] which was present in 41.3% of participants in this study (Table 2).

Abovementioned scoring tools were also compared between defined groups – genders, occupations, hospital sites, COVID-19 interactions, relationships and morbidity (Table 3). Significant differences were noted between hospital sites, with Site B reporting worse mean scores in depression (5.24 vs 4.08, $p < 0.01$), anxiety (4.66 vs 3.3, $p < 0.01$), stress (8.91 vs 6.33, $P < 0.01$) and PTSD (0.058 vs 0.043, $P < 0.01$) as compared to Hospital Site A. Similarly, HCWs with underlying medical ailments scored significantly higher across the DASS-21 and IES-R (Table 3).

63.8% participants offered suggestions on how working through the pandemic could have been improved, in terms of support of HCWs. Common responses included, but were not limited to, inclusiveness and involvement in decision making (86%), succinct and timely communication (83%), facilitating rest areas and staggered rosters (78%), improvement of staffing levels to facilitate effective patient care yet allow leave entitlements and social distancing (69%), on site mental health supports with a degree of personal interaction (66%), increased frequency of multidisciplinary educational and training sessions (66%) and development of childcare facilities (51%).

Table 1: Participant Characteristics at Baseline	
Average Age (IQR), years	40.7 (32 - 48)
Gender, % (n)	
Male	30.93 (146)
Female	69.07 (326)
*Relationship Status, % (n)	
Married	55.08 (260)
In A Committed Relationship	19.92 (94)
Single	18.22 (86)
Divorced / Separated	6.14 (29)
Widowed	0.64 (3)
Place of Employment, % (n)	
Hospital Site A	58.26 (275)
Hospital Site B	41.74 (197)
**Occupation, % (n)	
Doctor	19.28 (91)
Nurse	29.03 (137)
Clerical or Administrative Staff	13.77 (65)
Catering	1.48 (7)
Pharmacy	2.54 (12)
Security	4.87 (23)
Portering	1.27 (6)
Domestic	2.54 (12)
Laboratory	4.45 (21)
Maintenance	2.12 (10)
Healthcare Assistant	4.66 (22)
Allied Health Care	10.38 (49)
Management	0.64 (3)
Audiologist	0.42 (2)
Radiographer	2.54 (12)
Interaction with COVID-19 Patients, % (n)	
Yes	57.63 (272)
No	42.37 (200)
Underlying Medical Conditions, % (n)	
None	63.77 (301)
Hypertension	13.13 (62)
Dyslipidaemia	5.30 (25)
Elevated Body-Mass-Index	4.87 (23)
Diabetes	1.91 (9)
Obstructive Airway Disease	7.63 (36)
Heart Disease	0.63 (3)
Smoking	10.81 (51)
Other	4.45 (21)

Table 2: Prevalence of Depression, Anxiety, Stress and PTSD and Mean Scores of the DASS-21 and IES-R	
Mean Depression, Anxiety and Stress Scale-21 Scores, (IQR)	
DASS Depression	4.57 (2 to 7)
DASS Anxiety	3.87 (1 to 6)
DASS Stress	7.41 (4 to 10)
Depression, Anxiety and Stress Prevalence, n (%)	
Depression	201 (42.58)
Anxiety	213 (45.13)
Stress	213 (45.13)
Mean Impact of Event Scale – Revised Scores, (IQR)	
IES-R Avoidance	1.01 (0.38 to 1.50)
IES-R Intrusion	1.09 (0.38 to 1.72)
IES-R Hyperarousal	1.08 (0.50 to 1.67)
IES-R Total	0.05 (0.02 to 0.08)
PTSD Prevalence, n (%)	
	195 (41.31)

*For comparative analysis, participants either “Married” or “In A Committed Relationship” was classified as having Relationship Support, whilst “Single”, “Divorced / Separated” and “Widowed” were classified as Without Relationship Support. **Occupations were further grouped into Medical (Doctors and Nurses) and Non-Medical (All Others).

Characteristic	Proportion, %	DASS-21 Depression (Mean)	p-value	DASS-21 Anxiety (Mean)	p-value	DASS-21 Stress (Mean)	p-value	IES-R Avoidance (Mean)	p-value	IES-R Intrusion (Mean)	p-value	IES-R Hyperarousal (Mean)	p-value	IES-R Total (Mean)	p-value
Gender															
Male	30.9	4.34	0.38	3.44	0.07	6.99	0.15	0.91	0.06	0.98	0.08	0.96	0.02	0.043	0.02
Female	69.1	4.67		4.06		7.6		1.05		1.13		1.14		0.051	
Relationship Status															
Relationship Support	75	4.46	0.28	3.89	0.86	7.42	0.9	0.99	0.28	1.07	0.66	1.06	0.39	0.048	0.39
Without Relationship Support	25	4.88		3.82		7.36		1.07		1.11		1.14		0.052	
Place of Employment															
Hospital Site A	58.3	4.08	<0.01	3.3	<0.01	6.33	<0.01	0.89	<0.01	0.93	<0.01	0.95	<0.01	0.043	<0.01
Hospital Site B	41.7	5.24		4.66		8.91		1.17		1.3		1.26		0.058	
Occupation															
Medical	47.9	4.54	0.9	4.11	0.15	7.41	0.99	0.99	0.71	1.06	0.48	1.05	0.34	0.048	0.34
Non-Medical	52.1	4.59		3.65		7.41		1.02		1.11		1.12		0.051	
Direct Interaction with COVID-19 Patients															
Yes	57.6	4.57	0.91	4.13	0.05	7.39	0.96	0.99	0.61	1.07	0.67	1.07	0.73	0.049	0.73
No	42.4	4.53		3.49		7.41		1.03		1.1		1.1		0.05	
Underlying Medical Condition															
Yes	36.2	5.56	<0.01	5.05	<0.01	8.47	<0.01	1.2	<0.01	1.36	<0.01	1.32	<0.01	0.06	<0.01
No	63.8	4		3.2		6.8		0.9		0.93		0.95		0.043	

Table 3: Comparison of DASS-21 and IES-R Scores among Subgroups of Sample Population and Statistical Significance

DISCUSSION:

The ongoing COVID-19 pandemic is a global challenge which has resulted in significant mortality and morbidity worldwide, with more than 40 million cases and over one million deaths as of October 2020.[9] As the disease spreads at a rapid pace, most affected countries have had difficulties in meeting the demands for supply of personal protective equipment (PPE) and infrastructure. It has ravaged economies and social integrity, with a rising concern about mental health challenges.[10] With increased demands on an already taut healthcare sector, HCWs are faced with increased workload - with the ever-present risk of infection and the fear of transmission to their loved ones.[5, 11] Often times they require self-quarantine when in contact with COVID-19 confirmed patients; and when coupled with social isolation and discrimination - results in complex emotional reactions.[12] Furthermore, the conflict between professionalism and personal fear for oneself has been linked to burnout with physical and psychological manifestations.

A recent study involving 1563 health professionals reported that 50.7% of participants reported depressive symptoms, 44.7% anxiety and 36.1% sleep disturbance.[13] Similar findings were uncovered in our study; with 42.58% of our populace scoring positive for depression, 45.13% for anxiety and 45.13% for stress, as per the DASS-21.

Table 3 shows a significant difference between the hospital sites, with Site B demonstrating higher scores across all disciplines. It is important to note that Site B experienced significant nosocomial transmission and mortality related to COVID-19 compared to Site A. This demonstrates how experiences truly shape emotions.[14]

Likewise, individuals suffering from medical conditions presented with higher statistically significant scores, likely attributed to the fact that those with comorbidity experienced poorer outcomes if COVID-19 was contracted.[15]

Scores were largely statistically insignificant between other groups, but it is interesting to note that the mean scores were higher overall than scores obtained from Singaporean HCWs, where a comparable study was conducted.[6] This could reflect varied pandemic responses, resource allocation and other environmental circumstances.

A recent systematic review examined 61 viral epidemic outbreak studies and concluded that the prevalence of anxiety, depression, acute and post-traumatic stress disorder, and burnout was high during and after outbreaks; with problems having a long-lasting effect on the mental health of HCWs.[16] The prevalence of distress was higher than those being reported in our study, perhaps due to increased mental preparedness and rigorous infection control principles, as learnt from previous outbreaks.[6] The review also assessed the impact of educational and training initiatives employed to boost resilience and promote pandemic self-efficacy and interpersonal problem solving, of which had low evidentiary certainty.[15] In our study, more than 50% of sampled HCWs suggested the need for more education and training with a multidisciplinary approach, together with involvement in decision making. To boost morale, it has also been suggested to introduce shorter working periods, regular breaks and rotating shifts.

HCWs also recognised the need for psychological supports and we acknowledge the inadequacy of services to provide counselling for HCWs who have been dealing with infected persons; further limited by social distancing.

Our study is a mere snapshot of the present psychological state of our HCWs but we must prepare for future challenges. Many HCWs may develop PTSD, depression, anxiety and burnout *after* the cessation of

1 the pandemic, which becomes an urgent public health concern.[10] This is particularly worrying while
2 facing a likely resurgence of SARS-CoV-2 infection during the winter influenza season, when HCW resilience
3 may be low.[17]
4

5 The liaison mechanism of mental health services needs to be strengthened and improved with a
6 management system which promotes collaboration among organisations. Furthermore, the team of
7 mental health professionals needs to be expanded and strengthened. In an age of technological
8 advancement, online emergency psychological intervention based on artificial intelligence, community
9 based scientific dissemination and social bond enhancement, virtual reality and neuromodulation-based
10 intervention and human resources training for emergency intercession become more relevant, as
11 proposed by Chinese psychologists.[18]
12
13
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15 We recognize limitations in our study. Our findings rely on a self-reported survey which may question the
16 authenticity of response as well as give consideration to recall bias. A past medical history of psychiatric
17 disorders was not reported by participants, but we do recognise that this would be a significant risk factor
18 in scoring positively on our assessments. Socioeconomic status was also not recorded, which may be
19 important in evaluating associations of outcomes and tailoring specific interventions. Furthermore, the
20 study was conducted towards the end of the outbreak and at settings only in the south-east which impairs
21 the generalizability of the findings and lends to selection bias. Lastly, there was no pre- and post- COVID-19
22 pandemic study conducted, therefore it is difficult to ascertain whether it is truly COVID-19 or other
23 intrinsic or extrinsic factors accountable for the psychological impact seen.
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CONCLUSION:

COVID-19 carries significant mental health hazards; to date there is a paucity of research addressing the mental health issues during the pandemic. Psychological distress was found to be prevalent among HCWs at acute hospital settings in the south-east of Ireland. Screening for adverse mental and emotional outcomes and exploring the feasibility and efficacy of psychotherapeutic interventions, together with provision of support mechanisms for HCWs, are vital to protect their psychological well-being. It is important to note that matters can be both immediate and remote, and it will be important to examine the long-term sequelae of this contagion.

For peer review only

Author Contributorship:

The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. S.A. is the guarantor and had conceptualised and designed the study with support from M.D. and C.S. Data was collected by S.A. and E.M. with S.M. performing all our data analysis and interpretation. S.A. prepared the drafted article which was critically revised by C.S., S.M. and M.D., with the final approval of the version to be published given by all authors.

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Conflicts of Interest:

No competing interests. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical Approval:

The study has been reviewed and approved by the Research Ethics Committee, Health Service Executive (HSE), South-East, Reference Number 033/2020.

Transparency:

The manuscript's guarantor affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

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Data Sharing:

Data are available upon reasonable request. The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Patient consent for publication:

Not required.

Provenance and peer review:

Not commissioned; externally peer reviewed

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	7-8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	Report numbers of outcome events or summary measures over time	7-9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
5	Discussion			
6	Key results	18	Summarise key results with reference to study objectives	10-11
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10-11
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
10	Other information			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

22 *Give information separately for exposed and unexposed groups.

23 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
 24 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
 25 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
 26 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
 27 available at <http://www.strobe-statement.org>.